



Analysis of Crop Efficiency for Different crops in the Haridwar District

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Abstract

Haridwar District is belong to the Garhwal region of Uttarakhand known as Tarai-Bhabar region. The latitude of Haridwar, Uttarakhand, India is 29.945690, and the longitude is 78.164246. Kharif crops (Maize and Rice) and t Sugarcane is a whole year crop. The out of dominant ten crops, higher crop concentration 3.97 and 0.78 were observed in sugarcane and wheat crop respectively. But lowest crop concentration 0.01 and 0.10 were observed for barley and peas crops respectively. The Stability/sustainability Index values 0.79 and 0.74 are observed for rice and rapeseed and mustard respectively. The lowest value 0.42 was observed for masoor crop. The Relative Spread Index (RSI) The higher value 54.4 of the sugarcane was observed maximum but lowest value 0.016 observed for barley crop. The Relative Yield Index (RYI) the maximum values 154 and 142 for wheat and potato and minimum values 90 and 97 for peas and beans and Pulses and masoor crops. The average overall data series of twenty years observed Index of land- use Efficiency value was 41.1 for Haridwar and average value 36.8 observed. The indices are valuable for understanding of different crops efficiency in the study area.

Keywords: Cropping System; Efficiency; RSI; RYI; Sustainability and Indices

Introduction

The cropping patterns of a region are closely influenced by the geo-climatic, socio-economic, historical and political factors [1]. Cropping pattern is dynamic concepts due to the environmental conditions are not always same. The climatic factors are such as temperature, humidity, heat, air and cold or frost condition. Agricultural efficiency explains the yield per unit area of land and thus is an important attribute of agricultural system. The Rabi season crops are Barley, Gram, Wheat Masoor, Pea and beans, Potato, Rapeseed and Mustard and Rice and Maize are Kharif season crops. The sugarcane is whole year crop and production is good

and important cash crop. Agriculture is one of the primary sources of economic activity of the area. Agriculture is link with livestock population due to availability of green fodder to increase dairy production. The different cropping system is depend on suitable climatic and physical factors such as soil, climate (cold or warm season), humidity, temperature and intensity of light, the physical factors or technological factors irrigation, availability of improved seed or hybrid seed availability, marketing, fertilizers (organic or chemicals). The other factors are such as marketing, credit facilities, storage facilities, government policies and conservation program (updated information).

Agricultural efficiency is a vital indicator of the agricultural development as it is a scientific device to study the inherent fertility, productivity and capability of land. There are numerous factors which influence the agriculture efficiency of land including physical, social, economic and techno-organizational. The combined effect of these factors manifests itself in per acre yields as well as the volume of production in any given region [2]. Weather plays a decisive role in determining the existing cropping system such as Rice-Wheat, Mustard-Sugarcane-Ratoon-Wheat and Rice-Lentil cropping systems (<https://haridwar.kvk4.in> > district-profile)

Study area

Haridwar District in the Garhwal region is a district of Uttarakhand. It is divided into six development blocks (icssr.org). The district encompasses geographical area of 2360 sq km and has a population of 18,90,422 persons (https://www.indiastatpublications.com/District_Factbook/Uttarakhand/Hardwar).

The hilly region of the state consists of Uttarakashi, Tehri, Pauri, Chamoli, Rudraprayag, Almora, Bageshwar, Champawat, Pithoragarh and parts of Dehradun and Nainital districts (http://www.du.ac.in/du/uploads/Academics/centres_institutes/Agricultural_Eco/22.2015%20AGRI.Profile%20UK-Usha%20Tuteja,%202015.pdf). Agriculture is the main source of income for the people of Haridwar district of Uttarakhand. Majority of the population is dependent on agriculture and animal husbandry for their livelihood (District Profile: <https://haridwar.kvk4.in>). According to the 2001 census, there were 3.54 lakh main workers in the district. Nearly 40 per cent of workers were employed in agriculture. The total reported area of the district is 231,078 hectares. The district is relatively better off as more than half (52 per cent) of the area is under cultivation. Another 31 per cent area is under forest cover. The district is endowed with the perennial river i.e., Ganga. Ground water is available at the level of 150 to 300 feet in abundance. As a result, more than 85 per cent of net area is irrigated in the district. Tube wells are the main source of irrigation. More than 85 per cent of irrigated area is through tube wells in Haridwar. The share of river or canal irrigation is only 13.4 per cent (https://www.icssr.org/sites/default/files/districts/Haridwar_Final.pdf). In the presented paper, there are different indices analyses for year 2000-01 to 2019-20 in the study region.

Database and Methodology

The present study is based on secondary sources of time series data (Agriculture and Land use) of 20 years 2000-01 to 2019-20

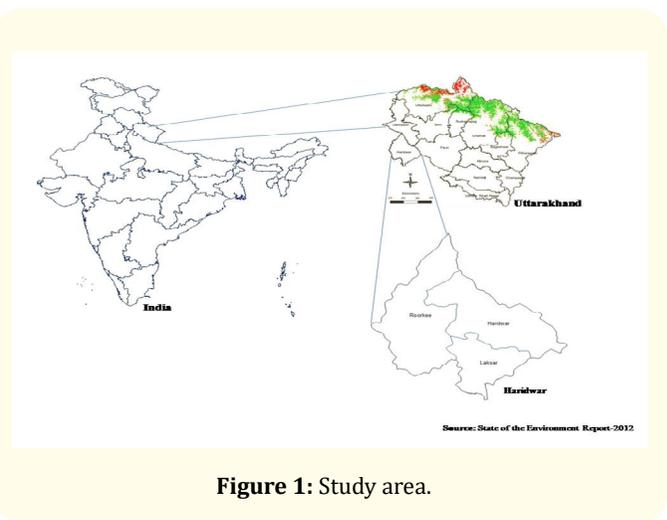


Figure 1: Study area.

were collected. The data collected from websites, published records, report and bulletin of the Directorate of Agricultural Statistics and the Institute of State Planning, U.P., Directorate of Economics and Statistics, ICAR, DRR CENSUS India and other national level institute. The different indices are used for analysis of different crops efficiency in Haridwar district.

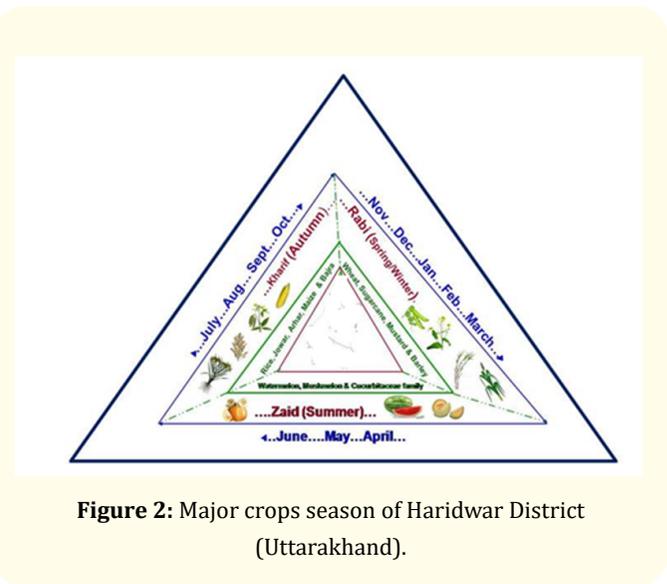


Figure 2: Major crops season of Haridwar District (Uttarakhand).

Index of determining concentration

The main crops of rabi and kharif season secondary data set taken for analysis In order to determine the district crop wise concentra-

tion of crops. Bhatia’s method (1965) [3] is used for the calculation of the location quotient. The following formula is used to work out the concentration of crop in the Haridwar district, Uttarakhand. The crop concentration index show higher index values represent high concentration and vice versa. On the other hand, if value of diversification comes close to 1, the diversification will be higher. In order to assess the crop combination, the following formula has been adopted.

$$\text{Index of determining concentration of Crop 'a'} = \frac{\text{Area of cropped area 'a' in the component area unit}}{\text{Area of all crops in the component area unit}} \div \frac{\text{Area of crop 'a' in the area entire region}}{\text{Area of all crops in the entire region}}$$

Higher the index value of a crop concentration indicates that higher is the area under that crop. This would give us an idea about the level of concentration of crop. This method is accepted in the present and categorized in three classes, viz. i) High, ii) Medium, iii) Low crop Concentration (Surendra, 2015) [4].

Stability/sustainability index

A good crop production technology should provide high yields under varying environmental conditions, i.e., keep yield fluctuations small. The statistical indicators of average dispersion, e. g. the while many small fluctuations are usually well tolerated by the farmer, an extreme yield may be a serious risk factor [5].

$$\text{Stability/sustainability Index} = \frac{\bar{Y}-sd}{Y_{max}} \text{ Where}$$

SI stability index, Y is the average yield over years n, sd is the standard. The data on percent area and Productivity of major crops for different districts of Uttarakhand were collected (indiastat.com) from these 20 years (2000-01 to 2019-20) were computed by using Kanwar (1972) [6] formula. The data related to area, production and productivity and total cultivable area of rabi crops in different districts.

Relative spread index (RSI)

It is the ratio of the area of the particular crop in percentage to total cultivated area in the district to area of that crop in percentage of the total cultivable area in the state and expressed in percentage [7].

$$RSI = \frac{\text{Area of the crop expressed as percentage to total cultivable area of district}}{\text{Area of the crop expressed as percentage to total cultivable area of state}} \times 100$$

Relative yield index (RYI)

It is the ratio of the mean yield of a particular crop in a district to the mean yield of that crop in the state and expressed in percentage.

$$RYI = \frac{\text{Mean yield of a crop in a district}}{\text{Mean yield of a crop in a state/region}} \times 100$$

the RYI and RSI were calculated separately for each year. The criteria for efficient cropping zone of the different districts and potential districts for major crops were identified. RSI > 125 and RYI > 100 shows most efficient zone for a particular crop/system

RYI		RSI		Cropping Zone
> 100	High	> 100	High	Most Efficient Cropping Zone (MECZ)
> 100	High	< 100	Low	Efficient Cropping Zone (ECZ)
< 100	Low	> 100	High	Not Efficient Cropping Zone (NECZ)
< 100	Low	< 100	Low	Highly Efficient Cropping (HECZ)

Table 1: Criteria for efficient cropping zone.

Index of land-use efficiency

The results of agricultural production depend on the effectiveness of the use of productive resources, primarily land. Economic efficiency of land use as a means of production is determined by comparing the results of production with the area or value of land [8,9]. Land use efficiency (LUE) refers to an increase in the output of a unit land area related to regional social and economic activities. The value nearing unity shows higher stability reflecting that the system is highly stabile.

$$\text{Index of land – use efficiency} = \frac{\text{Gross cropped area}}{\text{Net sown area}} \times 100$$

Results and Discussion

The analysis of major Rabi crops (Barley, Rapeseed and Mustard, Gram, Masoor, Peas and beans (Pulses), Potato and Wheat), Kharif crops (Maize and Rice) and Sugarcane is a whole year crop.

Index of determining concentration

A dominant crop of agricultural coverage density divides in high, medium and low categories depend on climatic different types of factors such as temperature, humidity, transport availability and

crop production. Index Determining Concentration of crops 'a' Higher the index value of a crop concentration indicates that higher is the area under that crop. The out of dominant ten crops, higher crop concentration 3.97 and 0.78 were observed in sugarcane and wheat crop respectively. But lowest crop concentration 0.01 and 0.10 were observed for barley and peas crops respectively. Both crops were also belongs to rabi season The wheat crop dominant and lowest value observed for barley crop in the rabi season and in whole year dominate crop was sugarcane crop in the area.

Stability/sustainability index

The analysis of crops data 2001-01 to 2019-20 observed stability index of different dominant crops. The high value of sustainability index is high stable of the crop in the area. The rice and rapeseed and mustard crops are more stable. The out of ten crops, values 0.79 and 0.74 are observed for rice and rapeseed and mustard respectively. The lowest value 0.42 was observed for masoor crop.

Relative spread index (RSI)

The data of Relative Spread Index for Rabi crops (Barley, Rapeseed and Mustard, Gram, Masoor, Peas and beans (Pulses), Potato and Wheat), The Kharif crops (Maize and Rice) and Sugarcane crops are observed maximum value for Sugarcane (54.4), wheat (34.6), rice (12.5). The lowest value of Relative Spread Index was observed for barley (0.016) and gram (0.019) crops in the Haridwar district (Table 2). The higher value 54.4 of the sugarcane was observed maximum but lowest value 0.016 observed for barley crop in the Haridwar district.

Relative yield index (RYI)

The analysis of crops data of Relative Yield Index was observed in main ten crops of Haridwar district. The maximum values 154 and 142 for wheat and potato and minimum values 90 and 97 for peas and beans and Pulses and masoor crops respectively.

Index of land-use efficiency

The agricultural production depends on the resources, primarily land. The Economic efficiency of land use of production with the area means value of the land. The analysis of cropped area and Net sown area data series (2000-01 to 2019-20) were observed. The Index of land- use Efficiency was observed in year 2001-02 the higher value 45.5 for Haridwar and in year 2011-12 the higher value 38.2 in year 2011-12. The lowest value was 36.1 was observed in year 2016-17 for Haridwar and the lowest value 35.5 observed

in the Uttarakhand. The average overall data series of twenty years observed Index of land- use Efficiency value was 41.1 for Haridwar and average value 36.8 observed [10-16].

Efficiency Indices value				
Season/Crops		Stability/ Sustainability Index (SI)	Relative Yield Index (RYI)	Relative Spread Index (RSI)
Rabi	Barley	0.49	116	0.016
Rabi	Gram	0.59	98	0.019
Rabi	Masoor	0.42	97	0.61
Rabi	Peas and beans (Pulses)	0.47	90	0.06
Rabi	Potato	0.55	142	0.20
Rabi	Rapeseed and Mustard	0.74	109	0.64
Rabi	Wheat	0.64	154	34.6
Kharif	Maize	0.63	114	0.76
Kharif	Rice	0.79	100	12.5
Whole Year	Sugarcane	0.61	100	54.5

Table 2: SI, RYI and RSI value of dominant crops.

Season/Crops		Index of Concentration (IC)
Rabi	Barley	0.01
Rabi	Gram	0.20
Rabi	Masoor	0.43
Rabi	Peas and beans (Pulses)	0.10
Rabi	Potato	0.12
Rabi	Rapeseed and Mustard	0.40
Rabi	Wheat	0.78
Kharif	Maize	0.23
Kharif	Rice	0.38
Whole Year	Sugarcane	3.97

Table 3: Index of Concentration (CI) of major crops grown in Haridwar District.

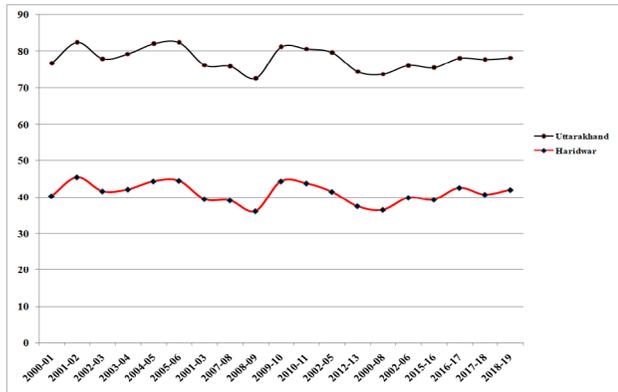


Figure 3: Index of Land-use Efficiency (LUE) of Haridwar District and Uttarakhand State.

Conclusion

The latitude of Haridwar, Uttarakhand, India is 29.945690, and the longitude is 78.164246. Weather plays a vital role in the determining of existing cropping systems such as Rice-Wheat, Mustard-Sugarcane-Ratoon-Wheat and Rice-Lentil cropping systems. The Rabi season crops are Barley, Gram, Wheat Masoor, Pea and beans, Potato, Rapeseed and Mustard and Rice and Maize are Kharif season crops. The sugarcane is whole year crop and production is good and important cash crop. The present study is based on secondary sources of time series data (Agriculture and Land use) of 20 years 2000-01 to 2019-20 were collected. The out of dominant ten crops, higher crop concentration 3.97 and 0.78 were observed in sugarcane and wheat crop respectively. But lowest crop concentration 0.01 and 0.10 were observed for barley and peas crops respectively. The high value of sustainability index is high stable of the crop in the area. The rice and rapeseed and mustard crops are more stable. Crop concentration represent the density of a crop which is occupied most of the agricultural coverage in the season. The higher crop concentration 3.97 and 0.78 were observed in sugarcane and wheat crop respectively. The Stability/sustainability Index values 0.79 and 0.74 are observed for rice and rapeseed and mustard respectively. The Relative Spread Index (RSI) higher value 54.4 of the sugarcane was observed maximum but lowest value 0.016 observed for barley crop. The Relative Yield Index (RYI) maximum values 154 and 142 for wheat and potato and minimum values 90

and 97 for peas. The Index of land-use Efficiency average overall data series of twenty years observed Index of land- use Efficiency value was 41.1 for Haridwar and average value 36.8 observed. The value of efficiency is observed in the study region.

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